

REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 7-25 are presently active, Claims 1-6 have been previously canceled without prejudice, Claims 9, 19, and 21 have been presently amended to address informalities identified in the Office Action. No new matter was added.

In the outstanding Office Action, Claims 9, 19, and 21 were objected to due to informalities. Claims 7-18 were rejected under 35 U.S.C. § 103(a) as unpatentable over Higuchi et al (U.S. Pat. No. 4,293,357) and in view of Gadkaree (U.S. Pat. Appl. Publ. No. 2002/0011683). Claims 18-25 were rejected under 35 U.S.C. § 103(a) as unpatentable over Higuchi et al and in view of Gadkaree.

Applicant acknowledges with appreciation the courtesy of Examiner Baldwin and Primary Examiner Zimmerman to interview this case on December 13, 2007 during which time the amendment filed December 7, 2007 was discussed as substantially summarized hereinafter.

Claim Summary: Independent Claim 7 as discussed during the interview presently defines a honeycomb structural body including:

a ceramic block made by arranging a plurality of through-holes side by side in a longitudinal direction through partition walls and sealing either one end portions of the through-holes,

wherein *the ceramic block comprises a composite material comprising ceramic particles and amorphous silicon.*

Independent Claim 13 defines a honeycomb structural body including:

a ceramic member having a plurality of through holes that are placed in parallel with one another in a length direction with partition wall interposed therebetween and are sealed at either one end portions of the through holes,

wherein ***the ceramic member comprises a composite material including ceramic particles and amorphous silicon.***

Independent Claim 19 defines a honeycomb structural body including:

a plurality of ceramic members combined with one another, the ceramic members each having a plurality of through holes extending in parallel with one another in a length direction with partition wall interposed therebetween and are sealed at either one end portions of the through holes,
wherein ***the plurality of ceramic members each comprise a composite material including ceramic particles and amorphous silicon.***

Thus, these independent claims define that the composite material of the honeycomb structural body includes amorphous silicon. The specification describes that, by the ceramic block including a composite material comprising ceramic particles and amorphous silicon, when the thermal stress is applied, even if fine cracks are created between ceramic particles, the growth of the cracks can be prevented.¹ Moreover, the amorphous phase in Applicant's claimed ceramic block is maintained and not converted to SiC. The specification states on page 22 that:

Next, the ceramic degreased body is heated to about 900-1100 °C to soften (fuse) the amorphous silicon powder, whereby the ceramic particles are bonded through the amorphous silicon to form porous ceramics, the whole of which can be integrally united to produce a honeycomb structural body (ceramic block) of the invention.

Further, the half-width value of Si peak (2θ = about 28°) in the X-ray diffraction of the thus produced honeycomb structural body becomes not less than 1.0°, and its crystallinity becomes low.

These anneal temperatures (as discussed below) are significantly lower than those used in Gadkaree where Gadkaree anneals at higher temperatures to "complete the conversion to SiC."

¹ The specification at page 7, lines 9-12.

Regarding the art rejections: The arguments filed on December 7, 2007 for patentability of the independent claims are represented here along with supplemental information related to the phase diagram of SiC. M.P.E.P. § 2143 requires for a *prima facie* case of obviousness that the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The outstanding Office Action acknowledged that Higuchi et al do not teach the use of amorphous silicon in the forming of a ceramic block (Office Action at page 3, lines 7-8). Thereafter, the outstanding Office Action relies on Gadkaree to remedy the deficiencies of Higuchi et al, stating that Gadkaree teaches that it is known to construct a ceramic honeycomb structure with amorphous silicon as well as silicon carbide. See Office Action at page 3, lines 7-8. The Office Action relies specifically on numbered paragraphs 26 and 30 and the Abstract of Gadkaree for this conclusion.

However, Applicants submit that Gadkaree, when considered as a whole, describes silicon carbide sintered bodies made from a raw material batch of a carbon precursor and silicon metal powder and fired to form a sintered SiC honeycomb structure. Specifically, Gadkaree describe:

[0024] This instant invention relates to a plasticizable batch mixture capable of being extruded into a silicon carbide green honeycomb body exhibiting surprisingly good strength; sufficient green strength to allow handling of the green honeycomb in a standard manufacturing process. Furthermore, this so-formed SiC honeycomb body formed from this inventive batch mixture can be dried, cured and sintered at temperatures as low as 1400 °C ***to form a sintered SiC honeycomb structure*** possessing good strength.

[0026] It is preferred that the ***silicon powder*** be comprised of a crystalline silicon powder. It has been found that the use of amorphous silicon metal powder in the subsequent formation process, as is standard in the prior art, results in an aqueous system that typically is subject to a reaction, and ***resultant foaming, between the silicon and water*** which is used as the preferred solvent for the resin. ***This foaming is particularly undesirable*** when forming honeycomb, or similar-type filtration structures, as it makes it particularly difficult to form structures exhibiting controlled wall uniformity, porosity and microstructure; i.e., difficulty in forming ceramic bodies

exhibiting the narrowed pore size distribution desired for filtration applications. ***It has been surprisingly found that the use of powdered crystalline silicon does not result in presence of foaming reactions when utilized in an aqueous system.*** As such, the use of crystalline silicon powder, in turn, allows use of water as the solvent and in the formation of an aqueous system. In short, the SiC formation process is much simpler, more economical, as water is an inexpensive solvent and requires no post formation handling or disposal of resultant water vapor. [Emphasis added.]

Moreover, the examiner will appreciate that Gadkaree further describes:

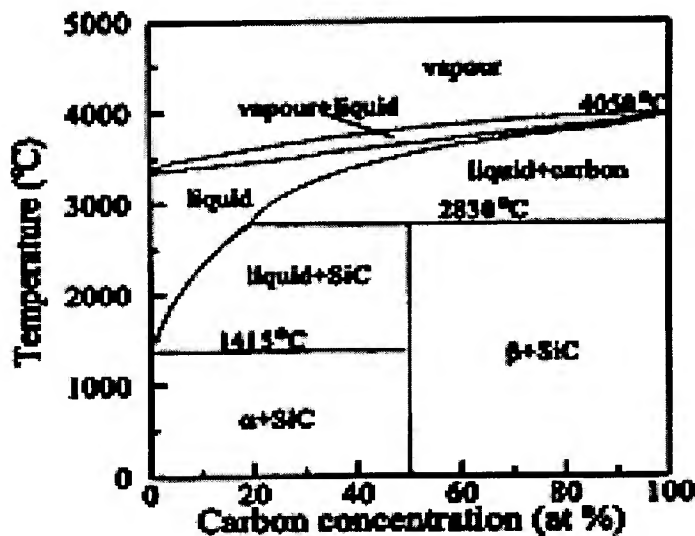
[0041] The very strong green structures are then fired in nitrogen at temperatures of between 700-1000 °C to carbonize the resin and to remove pore-forming fillers. The green structure should be fired for a sufficient period of time so as to complete the reaction of the metal and carbon to form silicon carbide. The carbonized structures ***are then fired*** at a temperature sufficient ***to complete the conversion to silicon carbide porous honeycombs***; i.e., very strong monolithic structures of silicon carbide exhibiting crush strengths in excess of 10 ksi.

[0041] Preferably, the firing is temperature range is ***between 1400 to about 1800 °C***; the ***resultant crystalline phase*** obtained by utilizing this firing temperature range is cubic silicon carbide. It is noted that, optionally the firing can be done at higher temperatures, ***up to 2400 °C***, if formation of the hexagonal or rhombic crystalline type of silicon carbide is desired. [Emphasis added.]

Hence, regardless of whether or not amorphous silicon powder or crystal silicon powder is used as one of the raw materials of the “batch mixture “of Gadkaree, the resultant structure consists of a crystallized silicon carbide structure.

Indeed, embedded herein is a phase diagram of SiC showing that at temperatures at 1415 °C, any excess of Si in the former green structure becomes molten Si.. Below 1415 °C for excess carbon, a solid solution of C known as α exists in with the SiC. Below 1415 °C for excess silicon, a solid solution of Si known as β exists in the SiC. This can be understood from the relative melting points, which for Si is 1412 °C and which for C is 3827 °C.

Thus, regardless of the carbon concentration at the temperatures used in Gadkaree, the silicon is either heated to a molten state (thereby leading to a polycrystalline phase on cool down) or the silicon is captured in the SiC phase.



Therefore, given the high annealing temperatures used in Gadkaree, Gadkaree does **not** disclose or suggest a ceramic honeycomb structure having a composite material comprising amorphous silicon and silicon carbide, as defined in the independent claims.

Hence, for this reason alone, a case of *prima facie* obviousness has not been established.

Furthermore, Gadkaree's teaching away from the use amorphous silicon as a raw material (see acknowledgement in the Office Action, page 3, lines 13-14) needs to be weighed in a favorable decision for non-obviousness. The Court in *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994) stated that:

A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or **would be led in a direction divergent from the path that was taken by the applicant**. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure **is unlikely to be productive of the result sought by the applicant**. [Emphasis added.]

Here, based on the teachings of Gadkaree, a person of ordinary skill would be led in a direction divergent from the path that was taken by the applicant and the line of development

flowing from Gadkaree (to form completed converted crystallized SiC) is unlikely to be productive of the result sought by the Applicant, where amorphous silicon is maintained in the resultant honeycomb structural body.

Thus, Gadkaree *teaches away* from the claimed inventions.

Recently, the Court in *KSR International Co. v. Teleflex Inc. et al.* 2007 U.S. LEXIS 4745 reinforced the role “teaching away” in deciding obviousness. The Court stated that:

In *United States v. Adams*, 383 U. S. 39, 40 (1966), a companion case to *Graham*, the Court considered the obviousness of a wet battery that varied from prior designs in two ways: It contained water, rather than the acids conventionally employed in storage batteries; and its electrodes were magnesium and cuprous chloride, rather than zinc and silver chloride. The Court recognized that when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result. 383 U. S., at 50-51. It nevertheless rejected the Government’s claim that Adams’s battery was obvious. The Court relied upon the corollary principle that when the prior art *teaches away* from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious. *Id.*, at 51-52. [Emphasis added.]

Here, for the facts of this situation, Gadkaree not only teaches away from the use of amorphous silicon in the starting materials (as acknowledged by the Office Action), but also teaches the firing of the green structures to temperatures where complete conversion to crystallized SiC or liquid phase Si occurs, which upon cooling would result in a polycrystalline Si phase. Regardless, in either case, Gadkaree teaches away from Applicant’s claimed composite material comprising ceramic particles and amorphous silicon.

Thus, for all these reasons, the 35 U.S.C. § 103(a) rejection over Higuchi et al and Gadkaree should be removed and the claims passed to allowance.

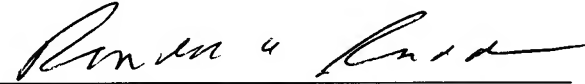
Accordingly, Claims 7 and 19 (and the claims dependent therefrom) are believed from similar reasons to be allowable.

Background references: Finally, as requested during the interview, attached herewith are machine translations of JP-A-2002-60279 and JP-A-2002-154876. Applicant's specification on pages 2 and 3 discussed these references for their reported use of "metallic silicon." The attached machine translations are being supplied as a courtesy in order for the examiner to more fully appreciate the differences between the claimed inventions and the background art of record. In particular, the examiner's attention is directed to numbered paragraphs [0102] and [0104] of JP-A-2002-6027 which show respectively (1) the inclusion of "metal Si powder" in a "plastic matter" including methyl cellulose and SiC powder and (2) the baking of the plastic matter at 1550 °C. Furthermore, the examiner's attention is directed to Claims 5- 6 and numbered paragraph [0035] of JP-A-2002-154876 which show the baking of metal silicon in a silicon carbide/silicon plastic matter from 1400-1600 °C. Hence, both of these background references are similar to Gadkaree (as discussed above) in that high temperatures (above the melting point of Si) are used which would eliminate the presence of any amorphous phase as the metal silicon becomes molten and either reacts to form SiC and/or precipitates upon cooling as polycrystalline Si. Indeed, numbered paragraph [0040] of JP-A-2002-154876 indicates that the "crystal phase" of SiC and Si was identified in the sintered compact by X-ray diffraction.

Conclusion: In view of the amendments and discussions presented above, Applicants respectfully submit that the present application is in condition for allowance, and an early action favorable to that effect is earnestly solicited.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Richard D. Kelly
Attorney of Record
Registration No. 27,757

Customer Number

22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 06/04)

Ronald A. Rudder, Ph.D.
Registration No. 45,618

RDK/AY/RAR/csc

Attachments: Machine translations of f JP-A-2002-60279 and JP-A-2002-154876

I:\ATTY\RAR\AMENDMENTS(2007)\263148US\SUPPLEMENTAL-REPLYTOOA09072007.DOC